

Air Deposition Modeling Update

CBP Manager's Meeting

November 3, 2015

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Modeling Team



Chesapeake Bay Program
Science, Restoration, Partnership

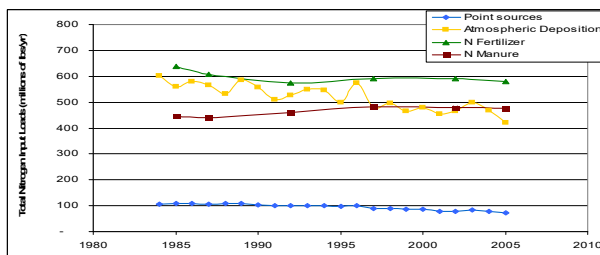


Overview of Where We Are now

- State of the science and progress in atmospheric **deposition** reductions:

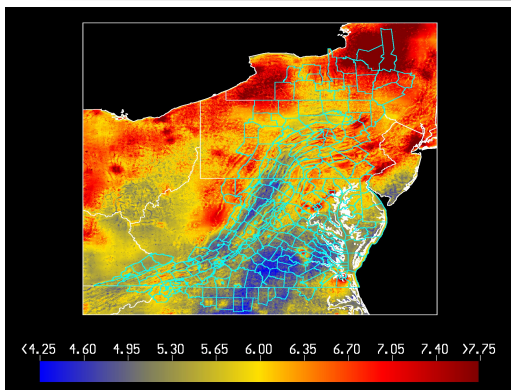
Atmospheric **deposition** is among the highest N loads in the Chesapeake watershed and tidal Bay, but it also has also high estimated N reductions.

- Future reductions are likely, but at reduced rate.
- New bi-directional ammonia CMAQ initial results to be combined with Penn State wet **deposition** estimates from 1984 to 2013 now underway. .



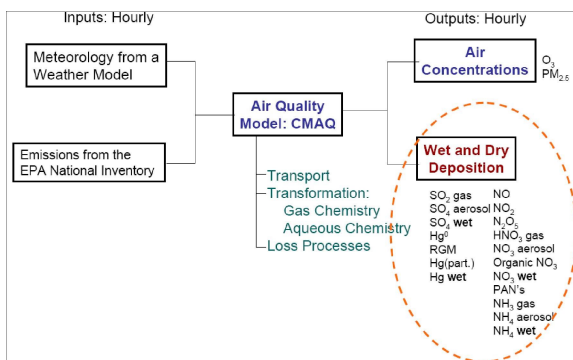


The CBP Airshed Model is Developed from a Penn State Wet Deposition Regression and CMAQ Scenario Information

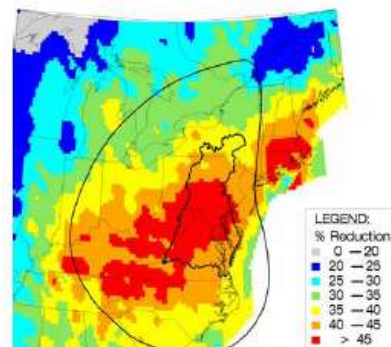


Combining
a regression
model of
wetfall
deposition...

...with
CMAQ
estimates
of dry
deposition
for the
base...



NOx SIP Reg +
Tier II Mobile +
Heavy Duty Diesel Regs
2020
ox-N Dep % Change from 1990

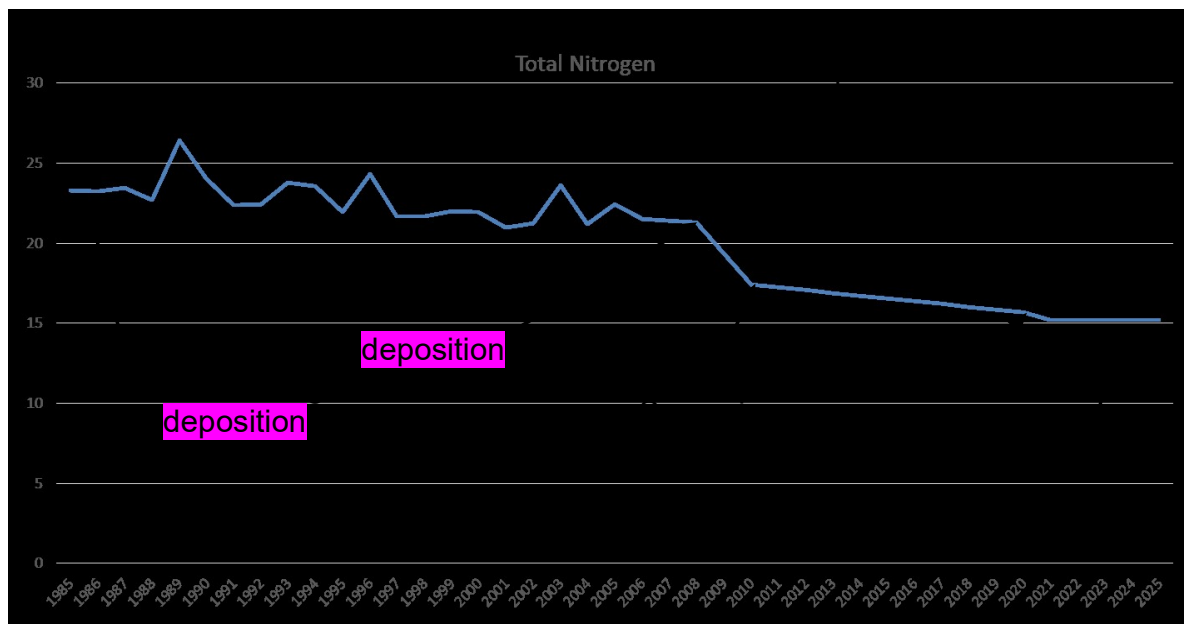


...and using the
power of the
CMAQ model for
scenarios.



Overview of Where We Are Now

Total Nitrogen Deposition to the Tidal Waters of the Chesapeake





New CMAQ Scenarios Being Prepared:

The 2002, 2011, 2018, and 2025 CMAQ Scenarios as well as a 2050 CMAQ climate change scenario are developed with CMAQ 5.0.2 which is the latest release. It has bidirectional ammonia simulated and all scenarios use a full year of meteorology of 2011. The WRF met model is used for the meteorological data.

The CMAQ model has a domain of all the US including some of southern Canada and some Northern Mexico. The CMAQ uses a 12 km grid size across the domain. The backcast scenario is to 2002.

All scenarios use 2011 NEI **emission** inventories and the EGU forecasts were by the IPM model. Mobile emissions were provided by the MOVES T3FRM, which was also used for the Tier 3 Rule. (A new version of MOVES just came out in 2014 but this version was not used.)

The new CMAQ runs will be applied in the integrated models used for Phase III WIPs in 2017.



What the CMAQ Scenarios Include

New Rules in Place or About to be in Play Along with Other Elements That Influence Atmospheric Deposition of Nitrogen in the Chesapeake Watershed

- **2015 ozone standard of 70 ppb** announced October 1, 2015 (2010 TMDL was an 80 ppb ozone standard – an estimated additional reduction of 1.8 million pounds TN to tidal waters of the Chesapeake) <http://www3.epa.gov/ozonepollution/actions.html>
- **Clean Power Plan** – announced August 3, 2015
<http://www2.epa.gov/cleanpowerplan/regulatory-actions>
- **Mercury and Air Toxics Standards (MATS)** <http://www3.epa.gov/mats/>
- **Tier 3 Vehicle Emission and Fuel Standards Program** – To be implemented in 2017
<http://www3.epa.gov/otaq/tier3.htm>
- **CAFE Rule** <http://www3.epa.gov/otaq/climate/regs-light-duty.htm>
- **RICE and related Stationary Internal Combustion Engine Rules**
<http://www3.epa.gov/ttn/atw/icengines/>
- **Cross-State Air Pollution Rule (CSAPR)** <http://www3.epa.gov/crossstaterule/>
- **Cement Rule** <http://www3.epa.gov/airquality/cement/basic.html>
- **Rules on Nonroad Engines, Equipment, and Vehicles** of all types
<http://www3.epa.gov/nonroad/>
- **Large Marine Diesel Rule - Category 3 (C3) have Tier 3 standards that begin in 2016.** <http://www3.epa.gov/otaq/oceanvessels.htm>
- **Other rules**
- **Consent decrees and Industrial facilities closures**



Key Points on 2015 Ozone Standard

DESIGNATIONS AND PERMITTING REQUIREMENTS FOR THE 2015 OZONE STANDARDS

On Oct. 1, 2015, the U.S. Environmental Protection Agency (EPA) strengthened the nation's air quality standards for ground-level. EPA will work closely with state (SIPs), local, and tribal air agencies to implement the ozone standards, beginning immediately. The agency's projections show the vast majority of U.S. counties will meet the standards by 2025 just with the rules and programs now in place or underway.

Highlights:

- EPA will designate attainment and nonattainment areas in late 2017.
- The agency will work closely with state, local and tribal air agencies to develop clean air plans for meeting ozone standards.



Key Points on 2015 Ozone Standard

Highlights (*continued*):

- Once EPA sets a new air quality standard, or revises an existing standard, the Clean Air Act requires EPA to designate areas as meeting the standards (attainment areas) or not meeting them (nonattainment areas) based on local air quality. Governors make initial designation recommendations, and EPA works closely with states and tribes as it determines initial designations and boundaries for nonattainment areas.
- All states with nonattainment areas must develop **emission** inventories and implement a preconstruction permitting program designed to provide additional air quality safeguards for those areas. States with nonattainment areas classified as “Moderate” or higher must develop state implementation plans (SIPs) showing how the areas will meet the standards. These states also must adopt reasonably available control technology (RACT) standards for certain types of **emission** sources in the nonattainment area.



Current Best Estimate of Ozone Air Quality Standard Reduction to 70 PPB

- The 2020 CMAQ Allocation Air Scenario used in the 2010 TMDL done with an assumed a 80 ppb ozone standard.
- The 2020 CMAQ Maximum Feasible Scenario assumes an ozone standard of 70 ppb.

We use the difference between the 2 above air scenarios to get about 1.4 million pound reduction from the watershed delivered to the Bay of an ozone standard that goes from 80 ppb to 70 ppb.

There is an additional 0.36 million pounds of TN reduction from the tidal Bay when going from 80 ppb ozone to 70 ppb ozone.

Overall reductions due to a decreased ozone standard are about **1.8 million pounds of TN reduction.**

BUT: 0.5 million pounds has already gone to New York's TN allocations.



Tier 3 Fuel Rule Reduction

First Cut, Preliminary Estimate of Tier 3 Fuel Rule on Reducing Chesapeake **Nitrogen** Loads:

- An estimated 0.8 million pound TN reduction delivered to the Bay from the watershed.
- An estimated 0.5 million pounds TN reduction to the tidal Bay.
- Total estimated reduction from the Tier 3 Fuel Rule is **1.3 million pounds TN.**

Calculations for Tier 3 Rule Estimate of TN loads reduced delivered to Bay	
FROM WATERSHED	
Current level of grams NOx/mile	0.07
Level of control of Tier 3 NOx/mile	0.03 Could even be less see slide 10 of "Tier 3 Proposal KEY Briefing, April 2012" PP file This is by the year 2025.
Mobile source emissions (2017)	53% See slide 5 of "Tier 3 Proposal KEY Briefing, April 2012" PP file
On Road Gasoline % of mobile sources	24% See slide 5 of "Tier 3 Proposal KEY Briefing, April 2012" PP file
Mobile sources gasoline	13% See slide 5 of "Tier 3 Proposal KEY Briefing, April 2012" PP file
Reduction of NOx by Tier 3	0.571428571
TN deposition to CB watershed 2020	320,000,000
NOx deposition to CB watershed 2020	160,000,000 Approximated by 50/50 split of NH3 & NOx assumption
Mobile sources - gasoline NOx load to CB	20,352,000
Reduction in gas mobile sources by Tier 3	21,629,714
Delivered to the Bay (75% delivery)	814,080
Basic estimate of about 0.8 million pound reduction to Bay by Tier 3 by 2025 from watershed.	
FROM TIDAL BAY	
Reduction of NOx by Tier 3	0.571428571
NOx deposition to tidal Bay 2020	6,520,000
Mobile sources gasoline	13% See slide 5 of "Tier 3 Proposal KEY Briefing, April 2012" PP file
Mobile sources - gasoline NOx load to CB	823,344
Reduction in gas mobile sources by Tier 3	473,913
2.96 million kg NOx to tidal Bay	
6,526,675 million pounds NOx to tidal Bay	



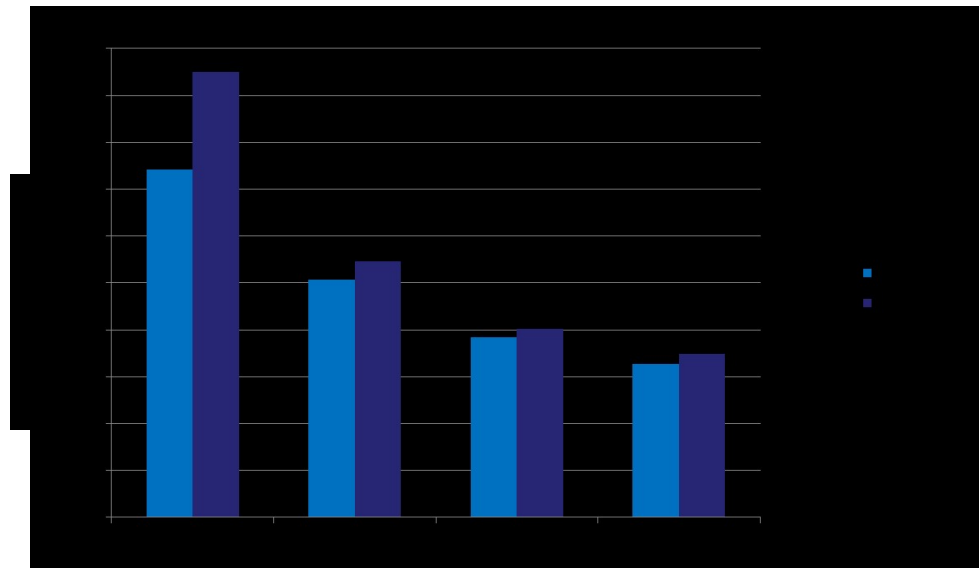
Proposed Carbon Rule Reduction

A First Cut, Preliminary Estimate of Proposed Carbon Rule on Reducing Chesapeake Nitrogen Loads:

- A preliminary, first-cut estimate of decreased nitrogen loads to the tidal Bay from direct deposition is 0.16 million pounds. For the watershed, the estimated 1% decrease in TN deposition from the proposed carbon rule is estimated to be a reduction of about 0.22 million pounds of nitrogen delivered to the Bay. (Based on 320 million pounds nitrogen deposition in 2020 and a 7% delivery factor of nitrogen deposition loads to the Bay.)
- The combined direct and indirect deposition estimated load reduction to the Chesapeake due to the proposed CO₂ regulations is about a **0.4 million pound reduction in delivered TN load** to the Bay.



Comparison of NO_x loads to Tidal Chesapeake from 2010 and 2017 CMAQ Scenarios

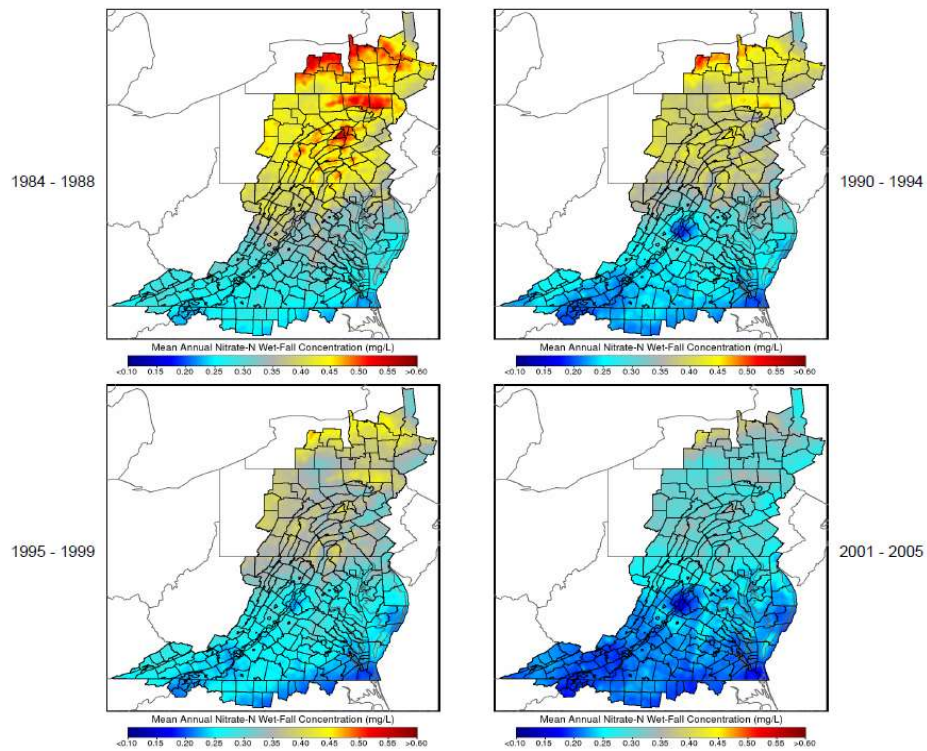


Better chemistry and better data sets (inclusion of lightning generation of NO_x, better mobile data, more accurate diurnal profile of CAFO emissions, etc.) leads to 2002 estimates of DIN deposition about 33% higher in the new CMAQ than the previous version, yet the new CMAQ 2025 estimate is about the same as our previous 2020 Air Allocation scenario.

Preliminary findings



The NADP Regression Model for the 1983-2013 period is also being developed for the 2017 Airshed Model



Mean annual nitrate-nitrogen (NO₃-N) wet-fall concentrations across the Chesapeake Bay Watershed region during four, 5-year summary periods as estimated by the Phase 2 daily nitrate wet-fall concentration model.



Conclusions:

- We've simulated and observed considerable reductions in atmospheric deposition of nitrogen from 1985 to the present.
- Reductions in atmospheric deposition are expected to continue, but at a reduced pace.
- The new Airshed Model is being developed with load estimates from both the bidirectional CMAQ simulation and the Penn State NADP Regression Model. Both elements will be operational by the first quarter of 2016 and provide new atmospheric deposition inputs for the final calibration of the Phase 6 and 2017 version of the WQSTM.



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